Introduction and Overview

The U. S. Environmental Protection Agency (EPA), in consultation with the Montana Department of Environmental Quality (DEQ), is proposing a plan to address 120 river miles of the Clark Fork River, from the headwaters at Warm Springs Creek to Milltown Reservoir (just east of Missoula), approximate boundaries are shown on the Location Map on Page 2.

EPA is the lead agency for the Clark Fork River Operable Unit (CFR OU), and DEQ is the supporting agency. Numerous other entities, including government agencies, local governments, the Confederated Salish and Kootenai Tribes, academic research groups, and public interest groups, have participated in the Superfund process up to the present. The potentially responsible party is the Atlantic Richfield Company.

This Proposed Plan describes EPA's preferred remedy, and the other alternatives EPA considered for river cleanup.

This proposed plan is provided in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), also known as Superfund. This presents the remedial strategies proposed by EPA Region 8 for the Clark Fork River Operable Unit (CFR OU) to the public for their consideration, review, and comments. It fulfills EPA's requirements under 117(a) of CERCLA and § 300.430(f)(2) of the National Contingency Plan (NCP).

EPA and DEQ may modify their respective preferences based on new information or comments from the public. The public is encouraged to review and comment on all the alternatives.

There will be a 60-day comment period from August 15 to October 13, 2002.

Send written comments to:

CFR Comments
Scott Brown or Wendy Thomi
U.S. EPA Region 8 (8MO)
10 W. 15th St.; Suite 3200
Helena, MT 59626

And / or comment in person on the record at:

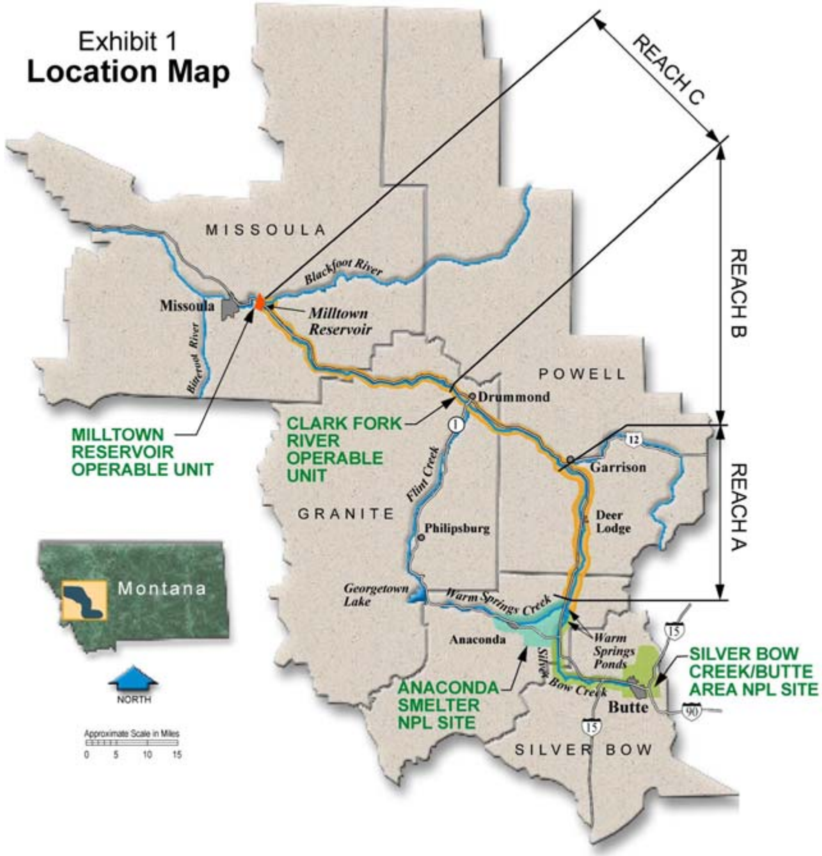
CFR OU Public Meeting
September 17, 2002
6:30 – 8:30 p.m.
Community Center
Deer Lodge, MT

or

CFR OU Public Meeting
September 19, 2002
7:00 – 9:00 p.m.
Holiday Inn Parkside
200 South Pattee Street
Missoula, MT

EPA's preferred remedy for the Clark Fork River Operable Unit combines portions of three alternatives. The following is proposed for Reach A and limited areas within Reach B. No action is proposed for Reach C (see Location Map):

- Areas of exposed tailings will be removed, with a limited exception.
- Some impacted soils and vegetation areas will be removed where depth of contamination prevents adequate and effective treatment in place or where saturated conditions make in-situ treatment unimplementable.
- The other areas of impacted soils and vegetation will be treated in place.



- Streambanks will be stabilized by “soft” engineering along both sides of the river for a total bank length of approximately 56 miles, and a 50-foot riparian buffer zone will be established on both sides of the river.
- Opportunity Ponds will be used for disposal of all removed contamination.
- Best Management Practices will be used throughout Reach A and in limited areas of Reach B to protect the remedy.
- Institutional Controls and additional sampling and maintenance will be required to protect human health.
- Monitoring during construction, construction Best Management Practices, and post-construction monitoring will be required.

Site Background

Miners began placer mining in the mid to late 1800s (in the Butte-Silver Bow Creek area), and soon began mining shallow underground deposits for gold, silver, copper, and other metals. Wastes such as copper, arsenic, lead, and zinc from these activities contaminated local areas, but did not contribute extensive tailings to the river. Shaft mining and milling of deeper copper sulfide ores in Butte and Anaconda began during the late 1880s and contributed most of the waste now found in the Clark Fork River. The introduction of electricity in the early 1900s and improved milling and smelting practices increased not only production rates, but also waste.

In Butte, mining companies disposed of mining and milling wastes in Silver Bow Creek into the 1900s. These wastes washed down Silver Bow Creek and into the upper Clark Fork River. The companies were eventually consolidated into the Anaconda Company. Large quantities of wastes from the Anaconda Company's operations in Anaconda also reached the Clark Fork River by washing down Warm Springs Creek and related tributaries. Discharges from underground mining, the pumping of Berkley Pit, and aerial deposition from the Anaconda Smelter operations also contributed waste.

In 1908, the largest flood event on record for the Clark Fork drainage occurred as a result of rain on snow and frozen ground. Flood waters transported large quantities of waste into, and down, the Clark Fork River. During subsequent annual snowmelt runoff and major thunderstorms, more wastes were, and are, transported as a result of higher stream flows.

By 1918, the first two sedimentation ponds were constructed at Warm Springs, just above the upper reach of the Clark Fork River. These dams and another built in 1959 removed some tailings and streambed sediments, preventing them from reaching the upper Clark Fork River. Since the mid-1970s, contaminant contribution to the Clark Fork River mainstem has occurred primarily through movement of previously deposited sediment and tailings.

How have the CFR and Floodplain been Studied?

Numerous sampling and various clean-up studies and demonstration projects have been implemented on the Clark Fork River. Atlantic Richfield Company conducted large portions of the Remedial Investigation and Feasibility Study (RI/FS) , and completed demonstration projects for in-situ treatment. EPA conducted oversight of the RI/FS activities, in consultation with DEQ, and conducted the Human Health and Ecological Risk Assessments, the geomorphological studies (primarily through U.S. Geological Survey and Atlantic Richfield Company), and the ARARs (legally applicable or relevant and appropriate requirements) assessment and identification. EPA and Atlantic Richfield Company relied upon other sampling and investigatory efforts conducted along the Clark Fork River as appropriate and consistent with the National Contingency Plan (NCP), including work performed as part of the natural resource damage investigations and responses by the U.S. DOI, the State of Montana, the Confederated Salish and Kootenai Tribes and Atlantic Richfield Company.

Key documents with detailed information about the CFR OU include:

- CFR OU Remedial Investigation Report Final Draft—ARCO 1998, approved by EPA.
- CFR OU Feasibility Study, Public Review Draft—ARCO 2002. This report contains a detailed list of applicable or relevant and appropriate requirements (ARARs).
- CFR OU Ecological Risk Assessment—prepared by Syracuse Research Corporation for EPA—2001.
- CFR OU Human Health Risk Assessment—prepared by Roy F. Weston Inc. for EPA—1998, and
- Human Health Risk Assessment Addendum Prepared by Syracuse Research Corporation for EPA—2001
- Geomorphology, Floodplain Tailings, and Metal Transport in the Upper Clark Fork Valley, Montana—USGS and ARCO 1998.

What Have been the Major Public Involvement Activities?

In 1995, EPA, in consultation with DEQ, prepared a community relations plan to identify and set forth agency and community interaction during the remedial investigation and feasibility study. EPA based the plan on EPA guidance, DEQ input, local government contact, and upper Clark Fork Valley resident interviews. EPA noted in the plan that a number of community involvement activities would be conducted including public meetings, media and mailing announcements and private interviews. Also, noted were names, phone numbers and addresses of EPA and DEQ officials, as well as where the public could read site documents. EPA, in consultation with DEQ, held meetings with local governments, basin residents, environmental groups, citizen groups, and other interested parties to solicit their concerns and suggestions for the Clark Fork River Operable Unit. Several public meetings were held and EPA hosted two open houses in April 2002. Public input has been important throughout the process.

Additionally, local governments hosted several meetings to solicit project information from EPA and DEQ. EPA also extended a technical assistance grant to the Milltown Technical Assistance Committee (later renamed the Clark Fork Technical Assistance Committee) to provide the public with independent technical reviews of EPA and DEQ Clark Fork River activities, reports, and meetings.

This proposed plan introduces the final phase of the remedial investigation and feasibility study process by presenting the public with the alternatives presented in the FS, presenting a preferred alternative, and soliciting written and oral comments. The comments will form the basis for EPA's further evaluation of the ninth alternative criterion, Community Acceptance, and will influence the selected remedy presented in the Record of Decision to be issued later this year. EPA, in consultation with DEQ, will provide written responses to public comments in a section of the Record of Decision known as the Responsiveness Summary.

Site Characteristics

As shown in the photo above, the absence or severe lack of vegetation on the floodplain tabs renders the floodplain vulnerable to destabilization through excessive erosion by large floods that could cause the river to unravel (change from single-channel to several shallow "braided" channels). The erosion problems contribute large amounts of sediment with contaminants to the river and contribute to accelerated loss of land and lower productivity.

The potential flood unraveling risk could change the Clark Fork River from a cobble-bed, single-thread meandering system to a braided system with dispersed contaminants, incapable of supporting trout. There is uncertainty associated with the probability and severity of this event.

1997 Flood on Clark Fork River

This photo was taken during a minor flooding event in 1997. Acidic runoff from exposed tailings, and particularly the green-blue copper salts visible in the photo, contributes high concentrations of dissolved copper to the river. This copper is highly toxic to aquatic life. That, and the lack of vegetation on the exposed tailings, led EPA to classify the exposed tailings areas as principal threat wastes in the CFR OU. Severely eroding banks, with exposed tailings and their lack of vegetation, are also considered principal threat wastes.

What are the Key Areas of Concern?

From its headwaters, the Clark Fork River flows north for approximately 43 river miles past the towns of Galen, Deer Lodge, and Garrison (this stretch is Reach A). The river then runs northwest for approximately 77 river miles to the Milltown Reservoir near Bonner (this includes Reach B and Reach C).

Reach A has the widest stretch of the 100-year floodplain and is nearest to historic mining and milling sites in Butte and Anaconda. At the starting point of Reach B, the Little Blackfoot River enters and seasonally may contribute a volume of water equal to or greater than the Clark Fork's. Throughout much of Reach B, the floodplain is more narrow and exposed tailings are much less extensive. Also, contaminated tailings have been mixed with floodplain soils to a larger extent. In Reach C, the floodplain is, to a large degree, constrained by a narrow valley, roads, or railroad beds. This reach is furthest away from historic mining sites, receives several tributaries that significantly increase flow, and exhibits floodplain soils mixed with contaminated tailings.

Studies performed for the *Remedial Investigation* and the *Feasibility Study* have shown that risks, both terrestrial and aquatic, are greatest in Reach A and in localized portions of Reach B. Remedial action in these reaches will result in the greatest risk reduction. In Reach B, limited cleanup will reduce localized terrestrial risks posed by small areas of exposed tailings. Reach C has more limited risks and no clearly feasible clean-up alternatives were identified.

What are the Contaminants of Concern?

The heavy metals and arsenic in the Clark Fork River Operable Unit, listed below, are from historic mining, milling, and smelting processes linked primarily to the Anaconda Copper Company operations in Butte and Anaconda:

Cadmium	**Arsenic**	**Lead**
Copper	**Zinc**	

EPA focuses on copper in this proposed plan because it is present in significant concentrations within the mining and smelting wastes, it has a large and consistent data set, it is the most toxic of the metals to aquatic life in this river system, and can be toxic to plants in the floodplain.

Nature and Extent of Contaminated Areas

Before mining and smelting, the upper Clark Fork River floodplain was composed of organic-rich, densely vegetated sediments and soils. Like most broad mountain valley floodplains, sediment deposition, channel configuration and vegetation types (primarily willow and other shrubs) were influenced primarily by beaver activity over many centuries. As mining and smelting wastes moved downstream from operations at Butte and Anaconda, the floodplain was altered significantly. Most of the wastes were deposited over the historic floodplain soils, leaving the organic-rich soils buried beneath layers of tailings, and mixed tailings and sediments. Over time, vegetation was decimated, but certainly not by any single event.

The floodplain of today, after 120 years of mixing, blending, and redistribution of tailings and sediments, under conditions of alternating floods, normal flow cycles and droughts, is characterized by heavy metals, arsenic and sulfides throughout. That is to say, the entire Deer Lodge valley floodplain–some 43 miles long and generally 300 to 500 feet wide–consists today of tailings, soils, and sediments that are impacted by metals, arsenic and acid-generating sulfides. By means of physical and chemical mechanisms alike, contaminants have migrated from the tailings to soils and sediments within the floodplain, as well as to shallow ground water and surface water. Exhibit 3c, which is the table accompanying the figure on page 9, shows (for Reach A only) geometric mean arsenic and copper concentrations of each soil type.

How do the Contaminants Move?

The primary source of contamination in Reach A is tailings, mine waste that contains heavy metals and arsenic, and tailings mixed with soil in streambanks and the floodplain. Contaminants move from tailings and impacted soils through the process of erosion, directly into the river and other surface waters. This movement provides pathways to terrestrial and aquatic life. In addition to erosion of tailings, metals are leached directly from the tailings into groundwater and surface water.

1. **Surface water**: Surface water runoff from tailings and contaminated soils into the river transports both dissolved and particulate-bound metals to aquatic life and creates surface water contamination.

2. **Groundwater**: Movement of groundwater through tailings and contaminated soil causes groundwater to become contaminated.

3. **Streambed sediments**: Stream sediments receive surface water contaminants and contain metal contamination.

4. **Historically irrigated fields**: Irrigation ditches and fields historically irrigated with Clark Fork River water have been contaminated by surface water contaminants. Arsenic from this deposition creates unacceptable human health risk for residences near or on it.

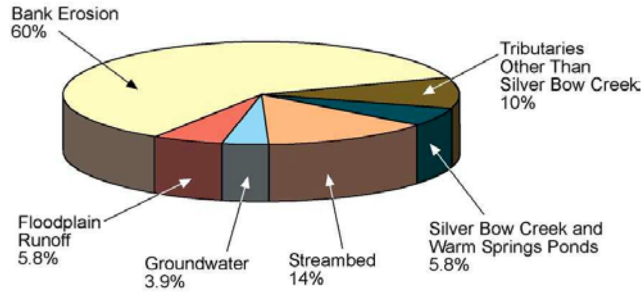
5. **Biological resources**: Aquatic plants and animals receive the contaminants through direct consumption of contaminated sediment, contaminated food sources, or through absorption in water. Contaminant uptake in plants is a well-documented occurrence, that prevents or limits vegetation on the land. Wildlife may receive contamination through soil, plant, and animal ingestion.

6. **Air resources**: Fugitive dust and air impacts are unlikely.

What are the Primary Sources of Copper?

During non-flood conditions, the largest source of copper to surface water in Reach A of the Clark Fork River is bank erosion (see Exhibit 2). Exhibit 2 shows that floodplain runoff is responsible for only 5.8 percent of the total copper load (primarily dissolved copper). However, it is this source of copper during pulse events (thunderstorms that create runoff into the river) that is judged by EPA to be the most harmful of all sources of copper to fish and other aquatic life. These estimates, however, represent copper loading during non-flooding events and do not take into account the erosion that occurs as a result of overbank flows during a flood. In addition, copper loading from both bank erosion (particulate copper) and overland runoff (dissolved copper) must be significantly reduced in order to achieve protectiveness and meet or come close to meeting ARARs. Streambed sediments make up 14 percent of the copper loading—the second highest source.

Exhibit 2



What Problems Does the Contamination Cause?

The floodplain is severely impacted by the presence of mining wastes. Tailings materials present in the root zone of riparian area soils are toxic to terrestrial plants. The most obvious instances of this are slickens areas—areas of exposed tailings that generally lack vegetation. These areas constitute the principal threat material at the Clark Fork River Operable Unit. Other areas, called impacted soils and vegetation areas in the FS, also present a risk. These areas of impacted soils and vegetation are due to buried tailings and contaminated soils.

The lack of floodplain vegetation is caused by metal contamination and related acid generation. This fundamental problem leads to a host of other impacts:

- Accelerated bank erosion and channel migration, causing unacceptable chronic risks to aquatic life and land use problems
- Vulnerability of floodplain to destabilization
- Potential and actual environmental hazards to terrestrial and aquatic life, especially from pulse and flood events
- Degraded groundwater quality
- Poor agricultural productivity
- Degraded surface water as a result of metals and sediments loading

In order to eliminate or reduce these impacts, EPA must address the problem of stressed or absent vegetation and the resulting surface water contamination. The illustration on the next two pages shows several key features of the floodplain, including the floodplain tab within the meander, exposed tailings, buried tailings, and sparse vegetation. The floodplain is shown in map view (Exhibit 3a) and as a cross-section (Exhibit 3b) to illustrate typical locations where contaminants are found within the floodplain, and the natural mechanisms that influence contaminant movement into the river or its impact on floodplain vegetation. The accompanying table (Exhibit 3c) shows the geometric mean concentrations for total arsenic and copper in Reach A.

A more detailed description of site risks can be found in EPA's Ecological and Human Health Risk Assessments. EPA's geomorphology reports prepared for the CFR OU also describe effects from terrestrial risk.

Scope and Role of Clark Fork River Operable Unit

The Clark Fork Basin Superfund complex is made up of four National Priority List (NPL) sites:

1. Silver Bow Creek / Butte Area Site—listed in 1983 and 1987
2. Montana Pole Site— listed in 1987
3. Anaconda Smelter Site—listed in 1983
4. Milltown Reservoir Sediments Site—listed in 1983

These sites extend more than 140 miles from the headwaters of Silver Bow Creek—north of Butte—through the Milltown Dam near Missoula (see map on page 2).

The CFR OU is one of three operable units (OUs) within the Milltown Reservoir Sediments Site. The other OUs are:

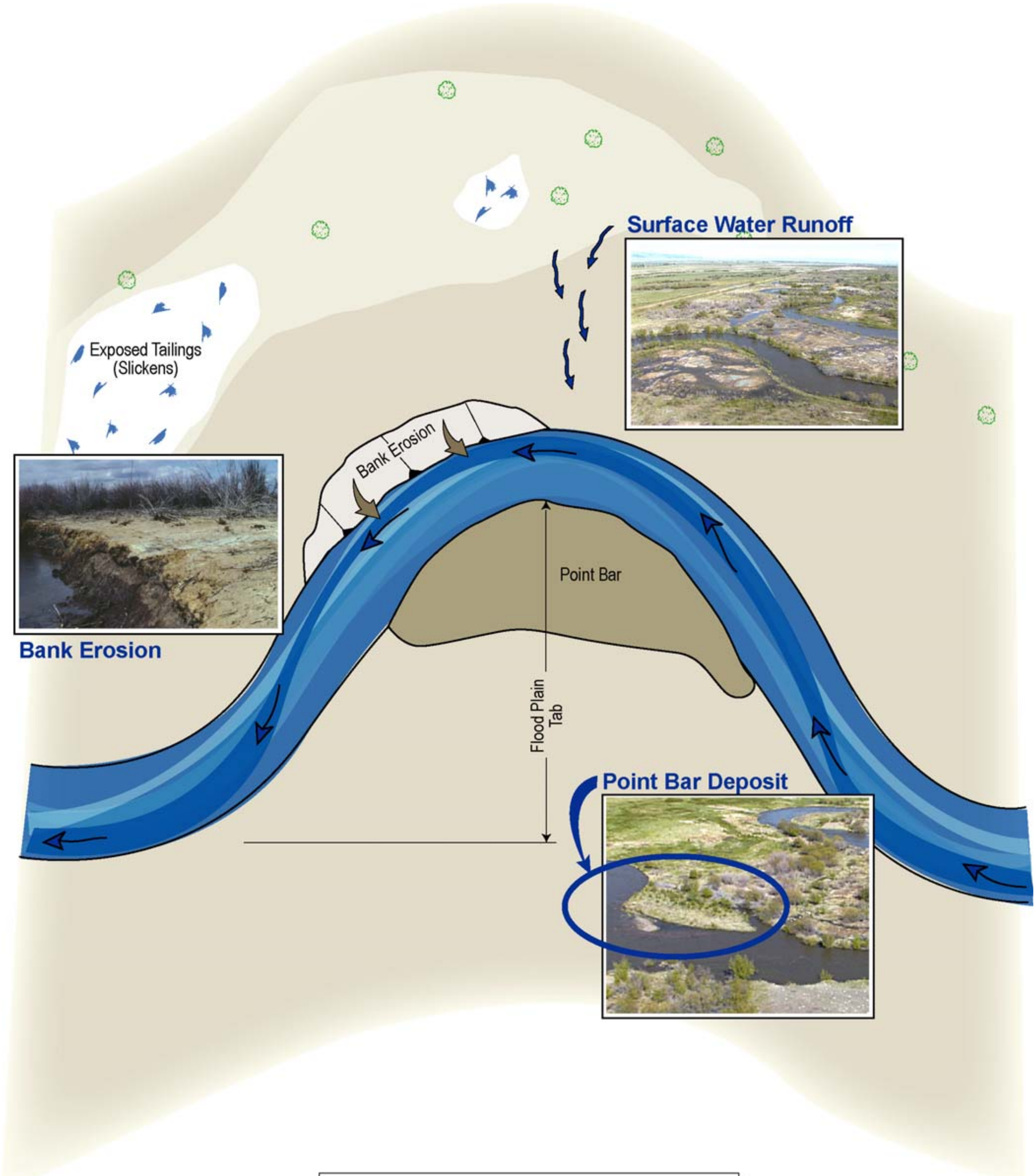
- The Milltown Water Supply
- The Milltown Reservoir Sediments

The CFR OU will address principal and low level threats to human health and the environment for the Clark Fork River. For example, the Deer Lodge Valley Historically Irrigated Lands Time Critical Response Action was a removal action within the CFR OU implemented to address threats to human health in areas near Deer Lodge, Montana, by cleaning up known yards and fields that exceeded risk-based criteria for arsenic in soils. It will become part of the CFR OU. The Water Supply OU addressed immediate threats to human health by providing an alternate water supply to residents of Milltown, Montana. The Reservoir Sediments OU will address principal and low level threats at the area in and around the Milltown Dam including the contaminated aquifer.

Summary of Site Risks

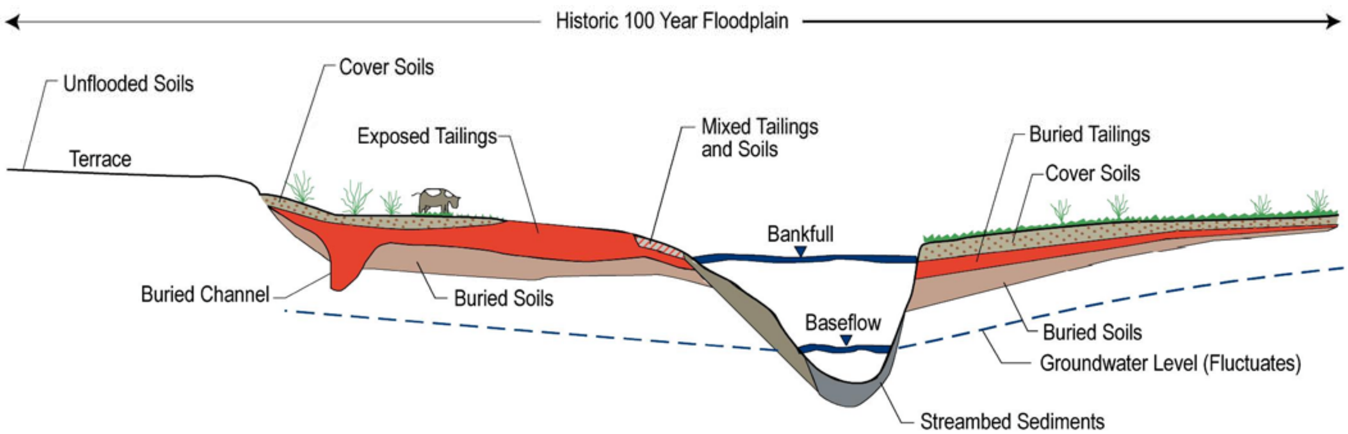
What are the Human Health Risks?

Land use along the Clark Fork River riparian zone is primarily recreational or agricultural. The Clark Fork River Human Health Risk Assessment (EPA 1998) and the Human Health Risk Assessment Addendum for Recreational Visitors at Arrowstone Park (EPA and ATSDR 2001) conclude that human health risks arising from exposures to heavy metals and arsenic within tailings deposits, soils and ground water along the river are "within the normally acceptable range." This conclusion is based upon the understanding that no residential development exists within the floodplain, and exposures are limited to ranch (or farm) workers and recreators (fishermen, tubers, and children at parks). On historically irrigated lands, however, where residential development has occurred or agricultural use occurs, or where it may occur in the future, the risk assessment concludes that risks may be unacceptable, or greater than the normally accepted range.



Existing Conditions (Pre-Remedy)

Exhibit 3A



Cross Section of Meander Bend

Exhibit 3B

EXHIBIT 3C
Geometric Mean Concentrations of Total Arsenic and Copper in Floodplain Sediments in Reach A

Soil Material	Arsenic*	Copper*
Exposed Tailings	791	1451
Buried Tailings	754	1940
Mixed Soil/Tailings	419	2360
Cover Soil	330	1980
Buried Soil	32	373
Unflooded Soil	63	303

*Arsenic and copper concentrations are in parts per million.

The conclusion that risks are low along the river is not because the contaminants are without the potential for causing harmful effects, but because human exposures to contaminants along the near-river corridor are low. Risks could be in a range of concern if permanent residences were maintained within the active floodplain. There, arsenic concentrations in soils and tailings, as well as in shallow ground water, often exceed acceptable levels for residential exposure (several hours of contact every day for many years). In addition, risks could be in a range of concern where residences have been constructed on lands that were historically irrigated with Clark Fork River water. The practicing of traditional cultural activities by members of Indian tribes in the floodplain may also result in exposures to site contaminants by persons engaging in these practices. Such exposures may be in addition to those expected from taking part in recreational and agricultural activities.

Arsenic in soils (whether near the river or on historically irrigated lands) is the primary concern for human exposures at this site. In assessing and managing risks where arsenic is present in soils, EPA developed "risk-based concentrations" (see discussion of risk based concentrations at page 12, under Remedial Action objectives). If an exposure area (such as Arrowstone Park, for example) has an average arsenic-in-soils concentration that is less than the risk-based concentration for recreational use, then EPA considers the risks to be within an acceptable range and no cleanup action is proposed. In contrast, EPA found several residential yards and children's horse pastures south of Deer Lodge where average soil arsenic concentrations were higher than the risk-based concentration for residential use. These risks were deemed unacceptable, and a cleanup of these soils was conducted where landowners granted access.

Shallow ground water along the river corridor (but generally not under historically irrigated lands) is contaminated with heavy metals and arsenic. If shallow wells (25 feet or less) are developed within the floodplain, for domestic purposes, unacceptable human health risks could result due to arsenic contamination.

Who Lives Along the River?

Approximately 5,830 people live within or adjacent to the CFR OU (Census and Economic Information Center 1995.) Approximately 77 percent (4,500) of the total population lives in or near Reach A (the Deer Lodge valley) between Galen and Garrison. Approximately 89 percent of the land within Reach A of the Clark Fork River area is privately owned, with the remaining 11 percent managed by federal and state agencies. The City of Missoula, with a population of 57,000, lies approximately 7 river miles downstream of the operable unit.

The entirety of the Clark Fork River Operable Unit is contained within the aboriginal territory of the Confederated Salish and Kootenai Tribes, who claim an ownership interest in natural resources in the Operable Unit based on the Hellgate treaty of 1855. Lands within the Clark Fork River Operable Unit are subject to certain treaty-reserved aboriginal uses by members of the Tribes.

What are the Ecological Risks?

The Ecological Risk Assessment established clear risks to the terrestrial environment along Reach A of the CFR OU. Limited risks were identified for Reaches B and C. Exposed tailings generally lack vegetation and impacted soils areas sustain reduced terrestrial plant species diversity and cover. This unacceptable risk is particularly important to agricultural landowners within the CFR OU. The geomorphic studies and evaluations have emphasized this risk, by noting that the Clark Fork River suffers from excessive erosion and loss of land; and by hypothesizing the potential for river unraveling in a severe flood event. While many of the erosional aspects of this geomorphic evaluation are documented in the geomorphology reports and understood, significant uncertainty is associated with the hypothesized floodplain unraveling risk.

According to EPA's *Ecological Risk Assessment*, historic impacts of mine waste on the Clark Fork

River were severe. The report indicates "essentially no fish existed in the upper Clark Fork River dating from the late 1800s into the 1950s." Fish populations began to re-establish to some degree after construction of the third Warm Springs sediment pond in 1959, and a new water treatment system for mine water discharge was installed in Butte between 1972 and 1975 that resulted in improved water quality. Documented fish kills, however, continued as late as 1991 and State studies show a significantly reduced trout population.

EPA also concluded from the risk assessment that copper (and possibly other metals) in the water and diet impose an intermittent, low-level chronic stress on fish. The most likely manifestation of this stress is decreased growth. It is unknown to what degree this chronic stress and/or an avoidance response contribute to the decrease in fish population in the river. The State believes this is an important area of risk. EPA considers it more likely that acute exposures to pulses of metals or other high-concentration events are more important than chronic stresses to both fish and other important aquatic invertebrates, since even intermittent fish kills from pulse events could lead to reductions in fish population. Such pulse events are also responsible for the intermittent fish kills that have occurred since fish populations began to re-establish in the 1950s. It is also considered likely that decreases in fish populations in the Clark Fork River may also be due in part to other (non-metal) factors, such as sedimentation caused by excessive erosion due to mining wastes. Considering all the available information, EPA has concluded that the risks to the aquatic system are unacceptable.

EPA must also give special consideration to the threatened bull trout in the Clark Fork River. Bull trout are listed as a threatened species under the Endangered Species Act, and EPA has a responsibility under the NCP to ensure that such species are sufficiently protected through remedy selection and implementation.

Finally, the Ecological Risk Assessment described potential risk to wildlife along the Clark Fork River corridor. There is considerable uncertainty associated with this potential risk, and EPA is evaluating follow up studies associated with this pathway and receptor group.

Based on the entire administrative record, including the Ecological Risk Asessment and the Human Health Risk Assessment and Addendum, and geomorphology reports, EPA's conclusion is that widespread unacceptable terrestrial and aquatic risk exists in Reach A and portions of Reach B of the CFR OU. EPA, in consultation with DEQ, has determined the Preferred Remedy identified in the Proposed Plan, or one or more of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment.

Remedial Action Objectives

For overbank tailings and impacted soils, the main Preliminary Remedial Action Objectives are:

1. For human health—prevent or inhibit ingestion of arsenic-contaminated soils/tailings where ingestion or contact would pose an unacceptable health risk.

2. For the environment—prevent or reduce unacceptable risk to ecological (including agricultural, aquatic and terrestrial) systems degraded by contaminated soils/tailings.

For groundwater, the main Preliminary Remedial Action Objectives are:

1. Return contaminated shallow groundwater to its beneficial use within a reasonable timeframe.

2. Comply with State groundwater standards, including nondegradation standards.

3. Prevent groundwater discharge containing arsenic and metals that would degrade surface waters.

For surface waters, the main Preliminary Remedial Action Objectives are:

1. Reduce or eliminate "pulses" of metals to the river, including those caused by snowmelt and thunderstorm events.
2. Achieve compliance with surface water standards, unless a waiver is justified.
3. Prevent ingestion of or direct contact with water posing an unacceptable human health risk.
4. Achieve trout-protective Toxicity Reference Values and acute and chronic Federal Ambient Water Quality Criteria.
5. Comply with stormwater ARARs.

The final *Human Health Risk Assessment* (EPA 1998) and its addendum (EPA 2001) and the Clark Fork River *Ecological Risk Assessment* (EPA 2001) provide numeric goals for the protection of human health and the environment.

ARARs provide other standards and criteria for the cleanup.

Surface Water
(based on 100 mg/l hardness,
total recoverable, acute, and chronic)

	Acute	Chronic	Human Health
Arsenic	340 µg/l	150 µg/l	10 µg/l
Cadmium	2 µg/l	0.25 µg/l	5 µg/l
Copper	18 µg/l	12 µg/l	1,300 µg/l
Lead	81 µg/l	3.2 µg/l	15 µg/l
Zinc	119 µg/l	119 µg/l	2,100 µg/l

Groundwater
(dissolved)

Arsenic	10 µg/1
Cadmium	5 µg/1
Copper	1,300 µg/1
Iron	300 µg/1
Lead	15 µg/1
Zinc	2100 µg/1

The risk-based concentrations for residential, recreational, and agricultural exposure are shown below. EPA considers acceptable exposure levels to be concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between 10^{-4} (1 in 10,000 probability) to 10^{-6} (1 in 1,000,000 probability), with 10^{-6} as the point of departure. EPA is proposing the following arsenic concentrations, which represent a 10^{-4} excess cancer risk.

- Residential—150 parts per million (ppm)
- Recreational—680 ppm (children at Arrowstone Park and other recreational scenarios)

  1,600 ppm for fishermen, swimmers and tubers along the river
- Agricultural/Ranch—620 ppm

Summary of Remedial Alternatives

In the *Feasibility Study*, eight primary alternatives were evaluated in detail. Many of these alternatives incorporate sub-alternatives that change some aspect of their remedial performance. For example, Alternative 4 generally consists of in-place remediation of exposed tailings and streambank stabilization. The sub-alternatives specify varying streambank lengths, different streambank treatments, and removal or in-situ treatment of varying estimated acreage of impacted soils. In total, 23 different approaches are evaluated, including no further action. The eight primary alternatives are described briefly here. A more detailed description of the alternatives can be found in the Feasibility Study.

The alternatives were developed to span the range of categories defined by the National Contingency Plan (40 CFR 300.430(e)) including, as appropriate:

1. The no action or no further action alternative.
2. A range of alternatives for source control in which treatment is a principal element. Treatment should reduce toxicity, mobility or volume of contaminants. This range includes alternatives that:

- Remove or destroy contaminants in order to eliminate or minimize the need for long-term management.
- Treat the principal threats but vary in the degree of treatment and the amount and characteristics of treatment residuals and untreated waste that must be managed.

3. A range of alternatives for source control that involve little or no treatment. These alternatives protect human health and the environment by preventing or controlling exposure to contaminants through engineering and institutional controls.

The FS screened out active groundwater, streambed sediment, and surface water treatment alternatives prior to the development and detailed analysis of alternatives because EPA's preference is to address the source of contamination. Therefore, the detailed alternatives only address solid media on the floodplain or in irrigated areas for remedial action.

The process of developing media-specific and combined-media alternatives for the Clark Fork River Operable Unit included a series of open meetings. Input was solicited from agency representatives, local governments, and members of public interest groups. Technology options for tailings and impacted soils, and eroding streambanks, were developed and assembled into eight primary alternatives. EPA approved the eight primary alternatives as the final list of alternatives to be carried into the detailed analysis of the *Feasibility Study*. Several details associated with the eight conceptual alternatives such as estimated acreage and depth of tailings were discussed and refined at a series of open working meetings spanning 6 months immediately prior to the release of the draft *Feasibility Study*. Generally, all alternatives except no action include the use of best management practices or land use management activities designed to protect the remedy of the floodplain and the streambanks, and to enhance or allow natural recovery.

Description of Alternatives	Sub-alternatives
Alternative 1: No Further Action (Cost $8,782,000)—Involves no further remedial action, beyond those currently in place or undertaken. Provides the baseline conditions against which the other remedial action alternatives are compared. Evaluation required by Superfund regulations.	Not applicable
Alternative 2: In-Place Reclamation of Exposed Tailings (167 acres) (Cost $13,393,000)—In-place reclamation of exposed tailings areas. Areas of buried tailings and impacted soils with or without impacted vegetation would not be reclaimed. These areas may be assigned "no further action," or may receive best management practices or land use management activities designed to enhance or allow natural recovery. Streambanks with tailings or impacted soils would be addressed with best management practices or land use management approach.	Not applicable
Alternative 3: In-Place Reclamation of Exposed Tailings and Other Impacted Soils and Vegetation Areas (Range of costs $16,369,000 - $29,310,000)—In-place reclamation of exposed tailings and in-place reclamation of buried tailings areas with impacted vegetation. Areas of buried tailings without impacted vegetation would not be actively remediated. These areas may be slated for no further action, or they may be addressed with best management practices or a land use management approach. Two different reclamation acreages were developed for this alternative and for alternatives 4, 5 and 6.) The alternative was divided into 3A and 3B sub-alternatives for the two acreages. These areas differ because two different methods have been used to estimate areas of impacted vegetation.	• Alternative 3A: In-Place Reclamation of Exposed Tailings and Other Impacted Soils and Vegetation Areas (285 acres). – 167 exposed – 118 buried • Alternative 3B: In-Place Reclamation of Exposed Tailings and Other Impacted Soils and Vegetation Areas (867 acres). – 167 exposed – 700 buried

Description of Alternatives	Sub-alternatives
Alternative 4: In-Place Reclamation of Exposed Tailings and Other Impacted Soils and Vegetation Areas with Streambank Stabilization (Range of costs $18,897,000 - $64,504,000)—Treatment of exposed tailings and buried tailings areas with impacted vegetation (the same as Alternative 3.) Alternative 4 goes a step further by addressing certain streambanks with a combination of best management practices, land use management, or in-place stabilization. Similar to Alternative 3, two different sub-alternative methods (4A & 4B) have been used to estimate areas of impacted vegetation. The sub-alternatives are further differentiated by four different streambank lengths identified for stabilization. Additionally, sub-alternatives 4A4 and 4B4 include a 50-foot buffer zone on each side of the active channel. Site conditions (including the presence of healthy woody vegetation) and the size and configuration of the floodplain tabs will dictate the choice and use of the following remedial activities within the riparian corridor buffer zone: • Maintaining the status quo for a particular section (where there is existing vegetation, particularly willows, sections of bank will not be disturbed other than to incorporate more dense vegetation) • In-situ treatment or select removal of near-channel tailings that would not otherwise support vegetation Woody vegetation capable of developing deep binding root mass and reducing shear stress against denuded banks will be established within the corridor buffer zone.	• Alternative 4A: In-Place Reclamation of Exposed Tailings and Other Impacted Soils and Vegetation (285 acres) with Streambank Stabilization. Includes 167 acres of exposed tailings and 118 acres of buried tailings with impacted vegetation. Further divided by amount of streambank treated: – Alternative 4A1: 22,367 feet of streambank. – Alternative 4A2: 72,777 feet – Alternative 4A3: 160,450 feet – Alternative 4A4: 264,000 feet plus 50 foot riparian corridor • **Alternative 4B**: In-Place Reclamation of Exposed Tailings and Other Impacted Soils and Vegetation (867 acres) with Streambank Stabilization. Includes 167 acres of exposed tailings and 700 acres of buried tailings with impacted vegetation. Further divided by amount of streambank treated: – Alternative 4B1: 22,367 feet of streambank. – Alternative 4B2: 72,777 feet – Alternative 4B3: 160,450 feet – Alternative 4B4: 264,000 feet plus 50 foot riparian zone
Alternative 5: Removal of Exposed Tailings and In-Place Reclamation of Other Impacted Soils and Vegetation, Opportunity Ponds Disposal Option (Range of costs $36,310,000 - $84,327,000)—Removal of exposed tailings only. Tailings areas with impacted vegetation would be reclaimed in place, and areas of buried tailings without impacted vegetation would not be reclaimed, but would be addressed with best management practices or a land use management approach. Where removal of exposed tailings intercepts streambanks, those streambanks would be reconstructed. Streambanks without tailings or impacted soils would be slated for no action or for best management practices and land use management. Alternative 5 requires removal and replacement of the approximately 167 acres of exposed tailings in Reach A. Removal options, presented as sub-alternatives 5A, 5B, 5C, and 5D, include removal of tailings plus 4 inches of underlying soil or removal of tailings plus 12 inches of underlying soil. Removed tailings and contaminated soils will be transported either to the Opportunity Ponds or to a series of local repositories located outside of the 500-year floodplain. **EPA's preferred remedy most closely resembles 5D, and adds elements from 4B4 and 6C.**	• Alternative 5A: – 167 acres of exposed tailings removed, plus 4 inches of soil – 118 acres of impacted soils and vegetation treated in place – Reconstruct 18,370 feet of streambank – Tailings transported to Opportunity Ponds • Alternative 5B: – 167 acres of exposed tailings removed, including 4 inches of soil – 700 acres of impacted soils and vegetation treated in place – Reconstruct 18,370 feet of streambank • Alternative 5C: – 167 acres of exposed tailings removed, including 12 inches of soil – 700 acres of impacted soils and vegetation treated in place – Reconstruct 18,370 feet of streambank – Tailings transported and deposited in local repositories built outside of 500-year floodplain

Description of Alternatives	Sub-alternatives
	• **Alternative 5D:** – 167 acres of exposed tailings removed, including 4 inches of soil – 700 acres of impacted soils and vegetation areas treated in place. – Stabilize 264,000 feet of streambank – Incorporates 50-foot buffer zone, similar to Alternative 4 – Disposal at Opportunity Ponds
Alternative 6: Removal of Exposed Tailings and Other Impacted Soils and Vegetation, Opportunity Ponds Disposal Option (Range of costs $48,225,000 - $110,478,000)—Alternative 6 calls for removal of exposed tailings and removal of areas of buried tailings with impacted vegetation. No in-place reclamation is proposed under Alternative 6. Areas of buried tailings without impacted vegetation would not be actively reclaimed, but would be addressed with best management practices or a land use management approach. Where removals intercept streambanks, the banks would be reconstructed. The amount of streambank reconstruction would be greater for Alternative 6 than for Alternative 5 because the additional removals would affect more streambank locations. Alternative 6 requires removal and replacement of the 167 acres of exposed tailings in Reach A plus all areas of buried tailings with impacted vegetation. Removal acreages in Alternatives 6A and 6B differ because two different methods have been used to estimate areas of impacted vegetation.	• Alternative 6A: – 285 acres of exposed tailings and other impacted soils and vegetation removed, including 4 inches of soil below each deposit – 43,845 feet of streambank stabilized • Alternative 6B: – 867 acres of exposed tailings and other impacted soils and vegetation removed, including 4 inches of soil below each deposit – 95,000 feet of streambank stabilized • **Alternative 6C:** – 867 acres of exposed tailings and other impacted soils and vegetation removed, including 4 inches of soil below each deposit – 264,000 feet of streambank stabilized – Incorporates 50-foot buffer zone, similar to Alternative 4B4
Alternative 7: Total Removal Unless Overlain by Woody Vegetation, Opportunity Ponds Disposal Option (Range of costs $161,614,000 - $179,381,000)—Alternative 7 is the near-total removal alternative that excludes removal in areas with existing woody vegetation. This alternative is intended to allow for as much removal as possible while leaving existing woody vegetation in place. Under Alternative 7, areas of exposed tailings without woody vegetation would be removed, areas of buried tailings with impacted vegetation but without woody vegetation would be removed, and areas of buried tailings without impacted vegetation or woody vegetation would be removed. Removals would occur in areas without woody vegetation within existing demonstration projects and other areas within the floodplain where tailings or metals-impacted soils were previously reclaimed using in-place reclamation techniques. Any buried tailings and metals-impacted soil areas that have woody vegetation would be addressed with best management practices, similar to Alternatives 2 through 6, and land use management. Where removals intercept streambanks, the banks would be reconstructed. Removal would be to a depth of 4 inches below the tailings, for an estimated total volume of 3.8 million cubic yards.	• Alternative 7A: Total Removal Unless Overlain by Woody Vegetation with Removal to the Opportunity Ponds Disposal Area: – 2,500 acres removed – 131,583 feet of streambank reconstructed • Alternative 7B: Total Removal Unless Overlain by Woody Vegetation to the Opportunity Ponds Disposal Area with Streambank Stabilization and a Riparian Corridor Buffer: – 2,500 acres removed – 264,000 feet of streambank stabilized – Incorporates 50-foot buffer zone, similar to Alternative 4B4

Description of Alternatives	Sub-alternatives
Alternative 8: Total Removal, Opportunity Ponds Disposal Option (Range of costs $355,370,000 - $368,438,000)—Alternative 8 is the total removal alternative. Areas of exposed tailings would be removed, and all areas of buried tailings, with or without impacted vegetation and with or without woody vegetation, would be removed. Where removals intercept streambanks, the banks would be reconstructed as described below. Streambanks without tailings or impacted soils would be slated for no action or for best management practices and land use management, similar to Alternatives 2 through 7. Removal would be to a depth of 12 inches below the tailings, for an estimated total volume of 9.1 million cubic yards.	• Alternative 8A: Total Removal with Transport to the Opportunity Ponds for Disposal: – 3,570 acres removed – 345,000 feet of streambank reconstructed • Alternative 8B: Total Removal with Transport to the Opportunity Ponds for Disposal plus Streambank Stabilization and Riparian Corridor Buffer: – 3,400 acres removed – 264,000 feet of streambank stabilized – Incorporates 50-foot buffer zone, similar to Alternative 4B4

Applicable and Relevant and Appropriate Requirements

CERCLA requires cleanups to comply with all ARARS unless a waiver is justified. The sidebar box on the next page summarizes the key ARARs for the CFR OU. The preferred remedy is expected to meet all ARARs except for the limited situations listed below in the ARAR waiver section. In those situations, alternative levels of ARAR conditions are presented.

ARARs Waivers for Certain Metals

Surface Water Standards

The Preferred Remedy proposes a waiver of the State's WQB7 standard for copper. The proposed waiver is based on the technical impracticability from an engineering perspective described at section 121(d)(4)(C) of CERCLA. EPA's analysis and basis for this determination is based on current modeling projections that none of the FS alternatives will achieve complete compliance, including Alternative 8, which calls for total removal of all exposed and buried tailings. The substitute standard would be the federal water quality criteria for copper. The performance standard goal for this replacement standard is to be in compliance during all conditions (low, normal and high flow and ice conditions) throughout the Clark Fork River. Compliance measurement and points of compliance will be detailed following the Record of Decision (ROD). They will be based, in part, on Clean Water Act protocols and regulations regarding length of time and sampling methodology required for noncompliance findings. The surface water quality standard for arsenic is the recently promulgated Safe Drinking Water Act federal standard of 10 ppb, dissolved. No waiver of this standard is proposed at this time. EPA and USGS are reviewing modeling information regarding projected compliance with arsenic standards, and a waiver may be invoked for certain events.

A possible additional basis for waiver is the "partial cleanup" waiver of section 121(d)(4)(A) of CERCLA. This waiver is based on cleanups occurring at other operable units such as those in Butte, Silver Bow Creek, Warm Springs Ponds, and other Anaconda area creeks, that could make compliance with WQB7 standards for some portions of the Clark Fork River, especially in upstream portions of Reach A, possible.

Groundwater Standards

No waiver of ground water standards is identified for the preferred alternative, although compliance with these standards is not expected immediately, but may occur within a reasonable time frame through a combination of the remedial measures described here and natural attenuation. As

Key ARARs at the Clark Fork River

- Water quality standards promulgated by the State of Montana
- Federal water quality criteria promulgated by EPA.
- The Federal drinking water standard for arsenic as applied to both surface and ground water.
- State and Federal Ground Water standards.
- Endangered Species Act requirements for animals and plants such as the bull trout—This requires EPA to consult with the U.S. Fish and Wildlife (USFWS) through a biological assessment and biological opinion. This helps ensure that the selected remedial action is protective of endangered species. Agencies design Remedial Action Measures to avoid or mitigate harm to the endangered species during implementation of the remedial action.
- State Solid Waste and Floodplain Management requirements regarding waste in floodplains—these standards and requirements generally prohibit the storage, active management, or disposal of wastes within a floodplain.

EPA has tentatively invoked waivers for State water quality and State Solid Waste and Floodplain Management requirements for the Preferred Remedy.

noted in the Preferred Remedy description, institutional controls to prevent ground water consumption until the time compliance is achieved are a necessary component of the remedy.

Floodplain and Solid Waste Standards

State of Montana floodplain and solid waste ARARs would require removal from the floodplain of any treated mine waste (treated tailings and soils mixed with tailings) unless a CERCLA waiver condition is invoked. For certain wastes in the floodplain, EPA is proposing use of the technical impracticality waiver found in CERCLA Section 121(d)(4)(c). The waiver would not apply to either exposed tailings areas or impacted soils and vegetation areas designated for removal in the preferred remedy descriptions. However, EPA has determined that there exists sufficient uncertainty regarding the technical impracticability from an engineering perspective for large-scale removal of impacted soils and vegetation areas, because the heterogeneity of the contamination in these areas would not provide for reliable removal of the contamination and would not allow the remedy to be implemented within a reasonable time frame. EPA proposes to invoke the waiver for these other impacted soils areas. These areas will generally be treated in place.

This waiver does not form a basis for a technical impracticability determination under any authority other than EPA's remedial action determination under CERCLA Section 121. It does not prevent or affect additional removal of mine waste or contaminated soils designated for treatment by the ROD through restoration projects, other projects under other authorities, or voluntary landowner efforts.

Evaluation of Alternatives

The Superfund law and regulations require that EPA, in consultation with DEQ, evaluate and compare the remedial clean-up alternatives based on the nine National Contingency Plan (NCP) criteria. These nine criteria are derived from the Superfund law, especially Section 121 of CERCLA, 42 U.S.C. § 9621, and are promulgated in the NCP at 40 CFR § 300.430(f)(1)(ii)(E). The nine criteria are presented in the box on the next page.

Any selected remedy must meet the **threshold criteria** of "overall protectiveness of human health and the environment" and "compliance with ARARs or appropriate justification for use of the CERCLA ARAR waivers." Only those alternatives that pass these criteria are considered further by EPA. The **balancing criteria of** "long-term effectiveness and permanence," "reduction of toxicity, mobility, or volume," "short-term effectiveness," implementability," and "cost" are used by EPA to identify and consider major trade-offs among the alternatives. Two of these criteria—"long-term effectiveness and permanence" and "reduction in toxicity, mobility, or volume"—are emphasized by the NCP and EPA guidance. The **modifying criteria** "State acceptance" and "community acceptance" are evaluated as the Preferred Remedy is selected to the extent that information is available, and then more thoroughly evaluated after the public comment period.

Regarding State acceptance, the State, through DEQ, will make its determination at the time of the issuance of the ROD. DEQ's programmatic preference for removal rather than treatment will influence its final site-specific decision. DEQ believes removal of contamination offers a more permanent and effective remedy where contamination can feasibly and reliably be removed. DEQ's potential concerns on the Clark Fork focus on surface and groundwater protection as well as ARAR compliance. DEQ anticipates considering public comment received on both the proposed plan and feasibility study prior to making its determination as to State acceptance.

The CFR OU has been the subject of intensive study and landowner and community input during the RI/FS process. This information has been very important in the development of the Proposed Plan and the presentation of the Preferred Alternative. These criteria will be more formally considered again after public comment is received on the Proposed Plan.

ARARs compliance presents difficult issues for the CFR OU. According to modeling projections, none of the alternatives are expected to fully comply with all surface water quality standard ARARs, and a waiver of the copper standard is justified. There is also uncertainty as to whether any of the alternatives can meet ground water standards within a reasonable time frame. Alternatives 2 and 3 present great uncertainty, Alternatives 4 through 5 present some uncertainty, and Alternatives 6 through 8 present less uncertainty for the ability to meet these ARARs. Waivers for important state solid waste and floodplain protection ARARs were considered possible for Alternatives 2 through 8. Accordingly, the agencies considered all of these alternatives further in the remedy selection process.

EPA'S Evaluation Criteria

Threshold Criteria—Must be Addressed

1. Overall Protection of Human Health and the Environment—*Must be protective of human health and the environment.*
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)—*Includes state and federal regulations; where ARARs cannot be met, a waiver is required*

Balancing Criteria—Must be Considered

1. Long-Term Effectiveness and Permanence
2. Reduction of Toxicity, Mobility, and Volume
3. Short-Term Effectiveness
4. Implementability
5. Capital and Operating and Maintenance Cost

Modifying Criteria—Must be Considered

1. State Acceptance
2. Community Acceptance

As described earlier, no further action was selected for Reach C. Ongoing upstream and Reach A and Reach B clean-up action is likely to address the limited risk from hazardous substance contamination found within Reach C. Given the low level of risk, it was determined that no reasonable or feasible cleanup action could be taken to address the Reach C contamination. Therefore, the remainder of the analysis is focused on Reaches A and B of the CFR OU.

EPA evaluates these criteria in detail in both the "detailed analysis" and a "comparative analysis of alternatives" sections of the *Feasibility Study*, which contains more detailed information. EPA, in consultation with DEQ, formally evaluated these eight alternatives and their sub-alternatives using the threshold and balancing criteria.

The Feasibility Study analysis demonstrates that Alternative 1, the no action alternative, does not address the unacceptable risks and pathways and is not considered further.

Alternatives 2 and 3 do not reliably address the risk pathways and receptors and leave large amounts of contaminants subject to residual risk within the ecosystem. They are not considered reliable or permanent. They are also not supported in initial input from the community or the State. Alternatives 7 and 8 address key ARAR compliance and reduction in mobility and volume to a greater degree than other alternatives. However, because of the large volumes of material which would be removed, they are difficult to implement in a timely fashion, pose a potential for short-term risk, and are relatively costly. Normally, a segment of the community does not support alternatives that will take a long period of time to implement, cause safety concerns, and may be intrusive to landowner use. Some landowners at this site have expressed these concerns to EPA. Accordingly, EPA is not giving further consideration to these alternatives for remediation.

Alternatives 4, 5, and 6 each have benefits and drawbacks as demonstrated in the Feasibility Study and its analysis of the nine criteria. The sub-alternative for streambank and riparian corridor protection developed by EPA and made a part of each of these alternatives was judged to be crucial for addressing overall protection of the environment. It addresses sediment copper loading, erosion risks and exposure pathways. Other streambank protection sub-alternatives do not fully address these pathways and are not reliable over time. This narrows the consideration to Alternatives 4B4, 5D, and 6C.

Alternative 4B4, in-situ treatment of slickens and impacted soils and vegetation, is more implementable, may have less short-term impact, and could be implemented in a shorter time period. Alternatives 5D and 6C are more likely to lead to ground water improvement and possible compliance with ground water ARARs. These alternatives are also projected to move closer to state water quality standards than Alternative 4B4 and would reduce the amount of fine-grained contaminated sediment in the river bed. These alternatives provide greater reduction in mobility and volume by removal of contaminants from the floodplain. Alternative 5D addresses the principal waste—slickens and phytotoxic streambanks—in a more reliable manner by removing these wastes from the floodplain. Alternative 6C, removal of exposed tailings and impacted soils and vegetation, has some shortcomings regarding implementability and short-term impacts, and it better addresses other factors such as long-term effectiveness, permanence, and reduction of toxicity and mobility. It does achieve ARAR compliance more fully than Alternatives 4 and 5.

EPA worked to identify the best combination of alternatives 4, 5, and 6 in order to match its technical evaluation of in-situ treatment that occurred as part of the Remedial Investigation / Feasibility Study (RI / FS) process. That technical evaluation, in EPA's view, demonstrated general reliability, with appropriate and careful implementation and operation and maintenance for in-situ treatment while identifying uncertainties for implementation of in-situ in areas with low pH such as slickens. The State questions EPA's technical basis for relying on in-situ treatment.

EPA is proposing a combination of Alternatives 4B4, 5D, and 6C as the Preferred Remedy. The Preferred Remedy reflects a fair balance between the long-term and short-term effectiveness and permanence, reduction of mobility, toxicity, or volume, and implementability issues associated with these alternatives. Removal of slickens, in most cases, and removal of impacted soils and vegetation areas as defined below, ensures overall protectiveness and long-term effectiveness. This also helps reduce reliance on long-term BMPs, institutional controls, and operation and maintenance. Use of in-situ treatment for significant portions of the impacted soils and vegetation areas will lessen short-term safety and environmental impacts, and allow for a faster remedial action construction period. EPA and DEQ aim to address concerns regarding the length of time and the intrusiveness of remediation by focusing on sequencing actions to allow for cleanup at various areas and a combination of techniques in a given area. Finally, State acceptance is important to EPA so removal of contaminants, as a more permanent and effective remedy, is reflected in the Preferred Remedy.

Key Guidance Documents

- The National Contingency Plan regulations, found at 40 CFR Section 300, and the statutory requirements of CERCLA—especially Section 121 of CERCLA, 42 U.S.C. Section 9621—are the mandatory requirements that EPA and DEQ must follow in selecting a remedy.
- In addition, EPA uses guidance as appropriate in the remedy selection process. Key guidance documents used for the CFR OU are as follows:
  - "A Guide to Selecting Remedial Superfund Actions," OSWER No. 9355.0-27FS (EPA April 1990)
  - "A Guide to Principal Threat and Low Level Threat Wastes," OSWER No. 9380.3-06FS (EPA November 1991)
  - "Rules of Thumb for Superfund Remedy Selection," OSWER No. 9355.0-69 (EPA August 1997)
  - "Incorporating Citizen Concerns into Superfund Decision Making," OSWER No. 9230.0-18 (EPA January 1991)
  - "The Role of Cost in the Superfund Remedy Selection Process," OSWER No. 9200.3-23FS (EPA September 1996)

These and other guidance documents are available at:

- http://www.epa.gov/superfund/resources/remedy/index.htm
- http://www.epa.gov/superfund/resources/policies/index/html.

Copies are available from EPA upon request.

Preferred Remedy

General Clean-up Strategy

The preferred remedy for the Clark Fork River Operable Unit is a combination of removal and treatment of contaminated mining waste and soils with streambank stabilization. It will be implemented in the banks and floodplain of all of Reach A and small, localized areas of Reach B.

This combination reflects the need to remove some of the contaminated areas while treating and improving other areas that have potential for more healthy vegetation. There is a strong bias to leave existing woody vegetation undisturbed and to improve poorly vegetated streambank areas because of its importance in preventing erosion, channel migration, and floodplain destabilization. All construction activities must carefully utilize construction BMPs to protect healthy vegetation and the river.

The preferred remedy addresses the need to complete a protective and permanent remedy in a reasonable period of time and at a reasonable cost.

The cost of the preferred remedy is estimated to be in the range of $90 to 100 million.

The preferred remedy, a combination of three FS Alternatives as described below, reflects the general clean-up strategy by requiring the following actions:

- Streambank and Riparian Corridor Buffer actions will use removal and in-situ treatment, along with Best Management Practices (BMPs), channel reconstruction, revegetation, and the planting of deep, binding woody and herbaceous vegetation. This will be done in phases, addressing the worst areas first.
- Exposed tailings, referred to as slickens, will be removed, with a limited exception. If the areas are too small, that is, less than approximately 400 square feet (small removal equipment must have room to operate), less than 2 feet in depth, and

contiguous with impacted soils and vegetation areas that will be treated in place, those areas may be treated in place.

- Impacted soils and vegetation areas will generally be treated in place, unless the tailings and impacted soils in a given area extend more than 2 feet below ground surface. In that case, the top portion of tailings will be removed so the remaining tailings and contaminated soils will be less than 2 feet thick. The remaining tailings and contaminated soils will either be treated in place or removed, depending on site-specific conditions determined with actual field data during remedial design. Other impacted soils and vegetation areas that are too wet to allow for implementation of in-situ treatment techniques will also be removed. EPA expects old river channels in the floodplain will often be removed rather than treated in-situ because of these criteria.
- Best Management Practices, or BMPs, will be required throughout Reach A and in parts of Reach B. BMPs refer to land management methods necessary to maintain the effectiveness of the remedy. Some larger removed areas may need less extensive and shorter term BMPs.
- EPA and DEQ would seek cooperation of landowners on the specific application of this remedy to a particular parcel of land. The agencies would work with the conservation district to ensure that BMPs are compatible with land uses by landowners.
- Institutional controls, continued operation and maintenance, and further recreational and residential evaluation are required for protection of human health.
- Construction and post construction monitoring of water quality and other environmental parameters is required.

Preferred Remedial Actions to Address Environmental Risks and Pathways

The environmental portion of the preferred remedy for the Clark Fork River combines portions of three FS alternatives: 4B4, 5D, and 6C.

Each of these above alternatives assumes that there will be a total of approximately 56 miles of streambank stabilization (both sides of the river), and this element of each alternative is included in the preferred remedy proposed here.

The blending of these three remedial alternatives brings removal and treatment actions plus streambank stabilization into an overall clean-up approach. Removal focuses on specific areas and conditions in streambanks and other areas on the floodplain where severe contamination complicates or prevents re-establishment of vegetation, thereby increasing the risk of further erosion of contaminants. These areas contain the mining wastes that present the principal threat to the environment. Treatment in place will be focused on other less contaminated areas with greater potential for re-vegetation. These areas contain the wastes that present a low- level threat to the environment.

Initial action will address the worst eroding streambanks that are toxic to vegetation and aquatic life by removing the tailings or contaminated soils and re-establishing necessary banks and vegetation to hold them in place. Areas of adjacent slickens will also be removed if they are accessible, unless they meet the limited exception to slickens removal set forth above. Removal action would also occur in impacted soils and vegetation areas where unusually deep or wet deposits of tailings are found, as described above.

In portions of the floodplain, contaminated streambanks and impacted soils areas do not need to be removed to meet remedial goals because they have existing vegetation that can be greatly improved and they can be readily and reliably treated. Impacted soils areas that are not too deep or too wet as described above will be treated in place. These actions, in combination, are expected to reduce contamination entering the river to an acceptable level. They will also improve floodplain vegetation, stability, and productivity.

The five main areas for action and general priority and preference for the type of remedial action in each area is as follows (see definitions on next page):

1. **Class 1 streambanks**: Removal of mining contamination, reconstruction, and revegetation of streambanks where chemical conditions do not allow the effective establishment of woody and herbaceous vegetation.
2. **Exposed tailings or slickens areas**: Removal of exposed tailings with the limited exception as described above.
3. **Class 2 streambanks**: Revegetate streambanks where chemical conditions (demonstrated by some significant level of woody and herbaceous vegetation) allow effective establishment of vegetation. Reconfiguring banks (e.g., scalloping or selective removal) could be required where other treatments may not be effective.
4. **Impacted soils areas with impacted vegetation**: in-situ treatment or removal, to be decided by the criteria described above.
5. **Class 3 streambanks**: Continue or apply Best Management Practices (BMPs) on all other streambanks with deeply binded woody vegetation and root-mass that maintains bank stability. BMPs are described in this plan.

The Riparian Evaluation System (RipES) is a decision making tool currently in draft form that will be further developed and used to more clearly identify areas for action. It is described in the attached appendix. For example, the RipES score for each area will help determine whether a streambank area is Class 1, 2, or 3, and which areas have impacted soils and vegetation. RipES will be developed so that it will accurately reflect the removal and in-situ treatment criteria set forth in the preferred remedy. Additionally, BMPs will be necessary for all of Reach A and portions of Reach B addressed in this action. EPA and DEQ plan to work cooperatively with landowners and the soil conservation district to establish and maintain these plans.

Remedial Actions to Address Human Health

The Feasibility Study noted a prior response action, the Deer Lodge Valley Historically Irrigated Lands Time Critical Removal Action, which addressed known and clearly unacceptable human health threats presented by the contamination at the CFR OU. The Feasibility Study noted that a continuation of the general approach taken in that action was appropriate for human health protection at the CFR OU. Accordingly, the proposed plan identifies the following actions which are necessary to ensure protection of human health at the CFR OU and are otherwise appropriate under CERCLA.

1. Action levels are developed for arsenic. Data analysis and the human health risk assessment and its addendum indicate that arsenic actions levels will address human health concerns for other contaminants of concern. Action levels for protection of human health are:

   - Residential—150 parts per million (ppm)

     Recreational—680 ppm (children at Arrowstone Park and other recreational areas) 1,600 ppm for fishermen, swimmers and tubers along the river

   - Agricultural/Ranch—620 ppm

These levels apply to exposure units for a given land use, and are measured by averaging samples within an exposure unit.

2. Many areas have undergone sampling and evaluation to address the arsenic action levels described above. Arrowstone Park, the recreational area near Deer Lodge prison, and the Eastside Ditch residential and agricultural area have undergone

Streambanks: The corridor from the active channel up to 50 feet out on either side.

Class 1 Streambanks: Phytotoxic conditions exist as demonstrated by inability of the active channel areas to support and sustain significant amounts of woody and herbaceous vegetation. Banks are actively eroding and are significant contributors to contaminant release to the river. Remedial actions for this class include removal of phytotoxic materials, reconstruction of the active channel, and revegetation with mature woody species. These actions may be implemented from the active channel to approximately 50 feet. Considerations include: depth of removal (this is not necessarily the same as depth of contamination), depth to the water surface, depth to groundwater, current bank stability, current vegetation status, infrastructure (bridges, culverts, etc.), surface drainage, landowner preferences, future land use, BMPs, and others.

Class 2 Streambanks: Non-phytotoxic conditions exist as demonstrated by some current woody and herbaceous vegetation, but banks are contaminated, not stable, and are eroding. Remedial actions for this class include supplemental revegetation and planting of mature woody species. Reconfiguration of the banks may require minor removal or in-place treatment. Considerations include current bank stability, current vegetation status, infrastructure, surface drainage, landowner preferences, future land use, BMPs, and others.

Class 3 Streambanks: These banks are contaminated but they have deep-binding woody vegetation holding the bank in place. Remedial actions include BMPs. Considerations: current vegetation status, current bank stability, knowledge of underlying contamination, landowner preferences, and current and future land use.

Slickens: Exposed tailings that generally lack vegetation and present the principal waste in the CFR OU, along with Class 1 streambanks. Estimated in the Remedial Investigation/ Feasibility Study at about 170 acres in Reach A, these slickens areas are contamination-caused largely bare ground. Scattered throughout Reach A, the areas number in the hundreds, are usually fractions of an acre in size, and are too toxic to support most vegetation or soil organisms. These areas have limited biological activity, are usually easy to spot, and are the biggest risk to fish and other aquatic invertebrates because of acidic, metals-rich storm runoff. Remedial action for most of these areas is removal. Removal of slickens areas adjacent to active channel are part of streambank remedial actions (above).

Impacted Soils Areas: Impacted soils and vegetation not on the banks. Estimated in the Remedial Investigation/Feasibility Study at about 700 acres in Reach A, these sparsely-vegetated areas amount to everything between slickens and "recovered" areas (areas that have an ecologically-sound plant community. Impacted soils areas will generally be treated in place, except as described above.

detailed evaluation and have either addressed human health risks or require no further action. Other areas—especially known recreational areas within the floodplain of the CFR OU and residential areas along irrigation ditches—will be sampled and evaluated against this criterion. If action levels are exceeded, removal and / or cover of contaminated exposure units must occur consistent with the manner addressed in the TCRA Memorandum. Any residential or agricultural areas within the TCRA area that have not yet been addressed must be completed. All areas addressed by the prior action or new actions are subject to operation and maintenance requirements, including weed control.

3. There are current prohibitions against building a permanent residence within the CFR OU floodplain enacted by Powell County. These prohibitions would be continued and enforcement and implementation of these actions would be provided.

4. Institutional controls to prevent ground water use of the shallow aquifer within the CFR OU for domestic purposes would be continued or enacted, with adequate enforcement and implementation funding provided.

The Role of Institutional Controls and Best Management Practices Land Use Plans

As described in the preferred remedy, institutional controls and best management practice land use plans (BMPs) are proposed to be important, supplementary parts of the selected remedy. Presented here is a general description of the institutional controls and BMPs that EPA sees as necessary for the remedy. EPA and DEQ will continue to carefully evaluate these aspects of the remedy during the public comment period. The Record of Decision will provide a more detailed description of institutional controls and BMPs, after consideration of public comment.

1. Educational efforts for recreational users within the river corridor area concerning the need to prevent soil intake by children and maintain other health practices, to prevent exposure of children, especially pica children, to contaminated soils in recreational areas. Funding for this effort will be provided by the potentially responsible party, and EPA plans to work with local and county officials for implementation of this program.

2. County zoning requirements to limit residential use of floodplain areas where waste is left in place. County zoning already exists for this Institutional Control in Powell County. Funding for implementation and enforcement of this requirement will be provided by the potentially responsible party.

3. Prevention of use of shallow ground water for domestic consumption or other consumptions that may spread the ground water contamination at the operable unit. There are several mechanisms that could be used to implement this institutional control—water control districts and petitions to the State DNRC, local and county ordinances, or specific deed restrictions or easements on contaminated land. The potentially responsible party would be required to fund and ensure implementation of these measures. EPA welcomes comment on the best and most efficient mechanism for this requirement.

4. Best Management Practice Plans. The box above identifies potential land use BMPs. These plans are owner specific, and ensure that revegetated areas—whether the subject of removal of contaminants, in-situ treatment of contaminants, or contaminants left in place—are appropriately managed so that operation and maintenance of these areas can occur and so that the important revegetation efforts are protective, comply with ARARs, and are sustained over time. The plans also ensure continued access, at appropriate times, by agency and Atlantic Richfield Company personnel to monitor and maintain the remedy. BMPs for removed areas would likely be less extensive and continue for a lesser period of time. EPA believes it essential that these efforts are implemented on a wide scale within the CFR OU, and funded by Atlantic Richfield Company in cooperation with the Department of Agriculture and local conservation boards. These efforts do not replace operation and maintenance or future work activities which remain the responsibility of the responsible party.

5. Dedicated use of recreational areas. Certain areas—notably Arrowstone Park—are found to be safe for general usage as recreational areas, if properly maintained. Funding and appropriate deed restrictions guaranteeing this use are necessary over the long term to address these important areas of public exposure as long as waste remains in place.

Potential BMPs

- **Prescribed Grazing Practices**
  Manage frequency, duration, season of use, intensity
  Riparian zone fencing
  Off-stream watering
  Temporary exclusion zones
- **Buffer zone for agricultural fields**
- **References:**
  - Best Management Practices for Grazing – Montana, DNRC
  - Prescribed Grazing Practices for Water Quality Protection on Montana Grazing Lands, Report to Montana DEQ, 2000.
  - NRCS Field Office Technical Guide for Agricultural Non-Point Source BMPs.

In order to track and measure progress toward achieving cleanup goals in the Clark Fork River, a long-term monitoring program that includes physical, chemical, and biological components is essential. It should be structured properly to detect and evaluate improvements and failures, both in the river and on reclaimed areas of the floodplain. It is expected that the present long-term monitoring program for the river would be supplemented by additional vegetation and groundwater monitoring of revegetated areas with funding to be provided by Atlantic Richfield Company.

Based on information currently available, EPA believes the Preferred Remedy meets the threshold criteria and provides the best balance of tradeoffs among the other alternatives with respect to the balancing and modifying criteria. EPA expects the Preferred Remedy to satisfy the following statutory requirements of CERCLA § 121(b):

1. Be protective of human health and the environment
2. Comply with Applicable and Relevant and Appropriate Requirements (ARARs) or justify a waiver
3. Be cost-effective
4. Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable
5. Satisfy the preference for treatment as a principal element.

EPA, in consultation with DEQ, also considers general program goals and expectations found in the NCP at 40 CFR § 300.430(a) when proposing a preferred remedy and ultimately selecting a final remedial action. Section 430(a)(1)(iii)(A) and EPA guidance states EPA's expectation that principal threat wastes will be addressed with reliable "treatment." For mobile waste in floodplains associated with acute risks, such as the exposed tailings and phytotoxic streambanks, this means removal and permanent disposal outside of the floodplain. Section 430(a)(1)(iii)(F) emphasizes the importance of restoring ground water to beneficial uses or, at least, preventing migration and exposure to contaminated ground water. These important considerations led EPA, in consultation with DEQ, to propose a preferred alternative that relies more on removal than remedial actions previously described by EPA. This preferred alternative better achieves ARARs compliance and provides for a more long-term and permanent remedy. Section 430(a)(1)(i) describes an important goal of maintaining protection over time, and the streambank and riparian corridor portion of the remedy is best suited among the streambank protection options to meet this goal.

Implications for the Landowners

There are nearly 100 landowners within Reach A where most of the cleanup is expected under all the alternatives but no action. The preferred remedy calls for approximately ten construction seasons (usually May through October of a given year) to complete. Each alternative, other than no action, produces two primary impacts on landowners: short-term impacts during construction, and long-term impacts due to modified uses. Certain impacts will be borne predominantly by the landowners. The preferred remedy seeks to address these impacts in the following manner. Consultation with individual landowners would be required in every instance:

Short-Term Impacts

Cleanup done tract by tract: The preferred remedy would be implemented landowner by landowner, limiting the amount of time on any individual landowner's property. For example, if riverbanks and riparian pastureland both needed to be addressed, cleanup would occur simultaneously at both pieces on this property. When cleanup work is finished construction equipment and personnel would be gone from the property.

No more than two construction seasons on the land: The preferred remedy would be designed and implemented to require the most efficient use of time on a landowner's property, with no more than two construction seasons on any landowner's property. For a small number of larger properties the two season construction time may need to be extended for another 2 years.

Long-Term Impacts

On-going uses would continue to the greatest extent allowable: With the exception of the banks and some sensitive riparian areas, wherever mine waste is removed, restrictions on the use of the land may cease once new vegetation is established. The preferred remedy would be designed and implemented to remove some of the mine waste, particularly where it poses a principal threat to the environment.

Where uses cannot continue as present, uses would be limited, not prohibited: The preferred remedy calls for managing land use within 50 feet of the river, and managing land use where mine waste exists but is not removed. The preferred remedy would be designed and implemented to allow as much of the historical use as possible while still maintaining the effectiveness of the cleanup.

Adequate funding would be provided to maintain recommended uses: Funding (for implementation of BMPs) would be provided to the landowners in the form of a grant through the U.S. Department of Agriculture. PRP funding for such a program is necessary. State and federal authorities would work with the individual landowners to assure adequate funding has been provided.

Sequencing the Preferred Remedy

The proposed clean-up plan for the CFR has a combination of removal and in-situ treatment, but the determination of which technique to use must be carefully decided on a site-specific basis.

The proposed sequence for action calls for remediating Class 1 streambanks first. Once the Class 1 streambank segments are identified, the adjacent exposed tailings and impacted soils and vegetation areas will be evaluated for necessary remediation and be remediated at the same time. Where slickens or buried channel deposits are present they will be cleaned up at the same time. Likewise, areas with impacted soils and vegetation will be evaluated for treatment or removal and done at the same time. This will minimize disruption to the floodplain and each individual landowner.

While the general approach will be to work from the headwaters down, the agencies believe remediation can be done more quickly and effectively and with less threat to river stability by working on discontinuous stretches of the river.

Exposed tailings isolated from Class 1 streambanks would be second on the list of priorities and will be remediated as described above. Class 2 streambanks would be third on the priority list for action. Fourth on the list of priorities for action are the impacted soils and vegetation areas that require in-situ treatment or removal as described above.

Timing of the remedial actions is an important implementation issue. One objective is to minimize the inconvenience to individual landowners. The overall project timeline for the 43 miles of river in Reach A and portions of Reach B is projected to be up to 10 years. This estimate may change during the design and construction phase. Individual landowner operating needs, availability of irrigation water, and the end land use determinations will also impact project schedules and timing.

The State of Montana's Natural Resource Damage Restoration Plan

The proposed plan sets forth the cleanup recommendation developed in accordance with criteria set out in CERCLA and the NCP for the remedy at the site. This remedy, among other things, is to attain protection of human health and the environment and is to comply with certain standards specified in related environmental laws (ARARs). However, the remedial action does not attempt to restore the area to its “baseline” condition, or the condition that would exist absent the release of hazardous substances.

The State of Montana is currently in a lawsuit with Atlantic Richfield Company, which seeks to assess and collect monetary damages for “injuries to natural resources” that have resulted from the release of hazardous substances into the Clark Fork River and its floodplain, as well as other areas in the Upper Clark Fork Basin. The costs necessary to restore the Clark Fork River and adjacent riparian lands to baseline conditions are being sought in the State's litigation. The State developed a restoration plan which, if implemented, would provide for certain actions to restore the injured resources. The State's existing plan is likely to be revised following issuance of EPA's ROD for the CFR OU.

The U.S. Department of Interior is also assessing injuries to Federally owned land along the Clark Fork River and determining restoration activities that may be appropriate there.

The proposed plan is not intended to and will not restore natural resources in and along the Clark Fork River, including trout and wildlife populations and fish and wildlife habitat, to baseline conditions.

Actions proposed in the State's and DOI's Restoration Determination Plans which would go beyond the scope of the proposed plan, in order to restore fish and wildlife populations and habitat to baseline conditions may include additional removal, additional streambank work, additional topsoil media, water flow enhancement, and additional vegetation requirements.

The implementation of the selected remedy may be coordinated to the maximum extent possible with the possible implementation of the State's and DOI's restoration plans in order to avoid duplication of effort and unnecessary costs and to maximize the benefits to the area.

Community Involvement

Public Meetings

EPA will hold two public meetings

- September 17, 2002, from 6:30 – 8:30 p.m.
  Community Center
  Deer Lodge, Montana

- September 19, 2002, from 7 – 9 p.m.
  Holiday Inn
  200 South Pattee Street
  Missoula, Montana

This will be an opportunity to provide written or oral comments.

Who to Contact with Questions or Concerns

U.S. Environmental Protection Agency

Scott Brown, Remedial Project Manager
(406) 457-5035
brown.scott@epa.gov.

Wendy Thomi, Community Involvement Coordinator
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thomi.wendy@epa.gov.

Montana Department of Environmental Quality

Robin Shropshire, State Project Manager
(406) 444-2885
rshropshire@state.mt.us.

Public Comment Period

EPA will accept written comments on its proposed clean-up plan for 60 days beginning on August 15, 2002, and ending on October 13, 2002. The Agency will make its final decision on the cleanup only after considering public comments. At the end of the comment period, EPA will include a responsiveness summary addressing the comments in the ROD. EPA will place all written comments and the Responsiveness Summary in EPA's Administrative Record for the Clark Fork River Operable Unit.

Administrative Record Review

The Administrative Record for the site contains documents that have been used to make decisions on how to clean up the site. The Record can be reviewed at:

EPA's Records Center
10 West 15th Street; Suite 3200
Helena, MT 59626
Phone: 406-457-5046
Monday – Friday

Some repositories have a microfilm version of the Record.

Information Repositories

Hearst Free Library
4th and Main Street
Anaconda, MT 59711
Phone: 406-563-6932

EPA Butte Office
155 West Granite
Butte, MT 59701
Phone: 406-782-3838

Montana Tech
1300 West Park
Butte, Montana 59701
Phone: 406-496-4281

Grant-Kohrs Ranch – National Historic Site
National Park Service
210 Missouri Avenue
Deer Lodge, MT 59722
Phone: 406-846-2070

Powell County Planning Office
409 Missouri Street
Deer Lodge, MT 59722
Phone: 406-846-3680

Mansfield Library
University of Montana
Missoula, MT 59812
Phone: 406-243-6860

Missoula City/County Library
301 East Main Street
Missoula, MT 59802
Phone: 406-721-2665

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Field tour on the Clark Fork River

Appendix

Summary of Riparian Evaluation System

Riparian Evaluation System Draft Document Clark Fork River Operable Unit, Milltown Reservoir Sediment NPL Site, Prepared by Reclamation Research Unit, MSU and Riparian and Wetlands Research Program, U of M for EPA, December 29, 2000.

Summary of Riparian Evaluation System

The Clark Fork River Operable Unit is large and complex. This complexity dictates that the Preferred Remedy be adapted to observed and measured spatial variability. Recognizing that the intensity of the preferred remedy is a technology continuum and parallels the continuum of ecological function found with the Clark Fork River Operable Unit, some distinct scientific approach is required to evaluate field conditions and then implement the appropriate remedial intensity. The Riparian Evaluation System (RipES) is being developed to fill this need. This system will be developed so that it will accurately reflect the removal and in-situ treatment criteria set forth in the preferred remedy.

The Riparian Evaluation System process integrates several CERCLA-mandated components into an objective process. This objective process is then used both to identify whether a remedial action is required for a specific land area and to define the type and intensity of remedial action required. The Riparian Evaluation System portion of this process can be applied in the following manner:

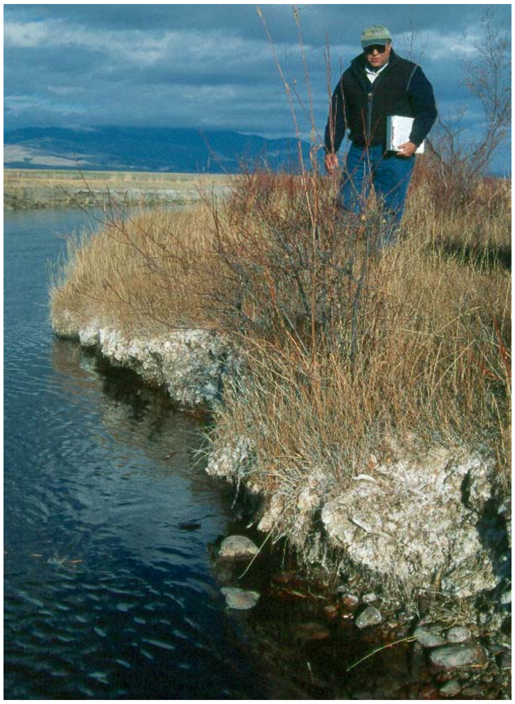
1. Delineate areas having similar ecological attributes on the aerial photographs.
2. Define polygons based on the Riparian Zone Inventory for the Clark Fork River (RWRP 1998).
3. Integrate existing data and information from appropriate sources (i.e., the *Remedial Investigation* and the Riparian Zone Inventory).
4. Conduct field reconnaissance of these areas and adjust polygon boundaries.
5. Score the ecological characteristics of each area.
6. Identify important modifying criteria for each area (polygon).
7. Delineate preliminary remedial units and assign preliminary remedial alternatives.
8. Generate data to identify the most appropriate remedial alternative for particular areas (polygon).
9. Prepare a preliminary remedial design report for these areas (polygons).

The vegetation community integrity, contamination severity, and landscape stability are the main components that will be numerically assessed in the Riparian Evaluation System. An understanding of the current status of these factors will help land managers decide if a remedial action is required and determine the type and intensity of that action.

Components of the Riparian Evaluation System

Plant Community Integrity

The integrity of the plant communities found within the operable unit is addressed in the Riparian Evaluation System by scoring important ecological parameters of vegetative cover, the incidence of invasive species, the extent to which preferred plant species are present within a defined polygon, and the amount of standing decadent and dead woody material. The numerical rating given to each of these parameters and how each is to be consistently assessed in a field setting are presented in full detail in the draft Riparian Evaluation System document (RRU and RWRP 2000).



The Riparian Evaluation System is an objective, scientific process used to identify the remediation action needed at each location.

Landscape Stability

Landscape stability within a selected polygon relates to the potential for the release of contaminants via multiple pathways. The significance of the pathway changes as a function of the landscape. For example, soils on historically irrigated fields are often more subject to wind and stormwater erosion than soils found in well vegetated and flat wet meadows. Soils adjacent to streambanks bound by deep woody vegetation are less likely to release contaminants to the river than those banks with little streamside vegetation. The numerical rating given to each of these parameters and how each is to be consistently assessed in a field setting are also presented in full detail in the draft Riparian Evaluation System document (RRU and RWRP 2000).

Contamination Severity

The severity of contamination within a polygon may have a profound effect on the ecological nature and function of the plant community. Tailings are present in some areas adjacent to the river surface. These surface tailings limit the number of species that can tolerate this environment. Buried tailings may also reduce the number of plant species present, depending on the depth of the contaminated materials and the concentration of metals in the tailings. Other factors may mitigate the effects of these metals (for example, ample water in the root zone), or exacerbate the metals effects (for example, through high hydrogen ion levels [low pH], and drought conditions). Contamination severity parameters scored in the Riparian Evaluation System quantitative portion include the volume and concentration of the contaminants, the geochemical mobility of the contaminants, contamination-caused or tailings-caused bare ground, and the proximity of the contaminated materials to the streambank or the shoreline. The numerical rating given to each of these parameters and how each is to be consistently assessed in a field setting are presented in full detail in the draft Riparian Evaluation System document (RRU and RWRP 2000).

Decision Diagram

The Riparian Evaluation System Soil Decision Diagram demonstrates how quantitative scores collect by field evaluation are tempered by regulatory and site-specific circumstances to arrive at an appropriate remedial action consistent with statutory guidance. The decision

Riparian Evaluation System (RipES) Soil Decision Matrix

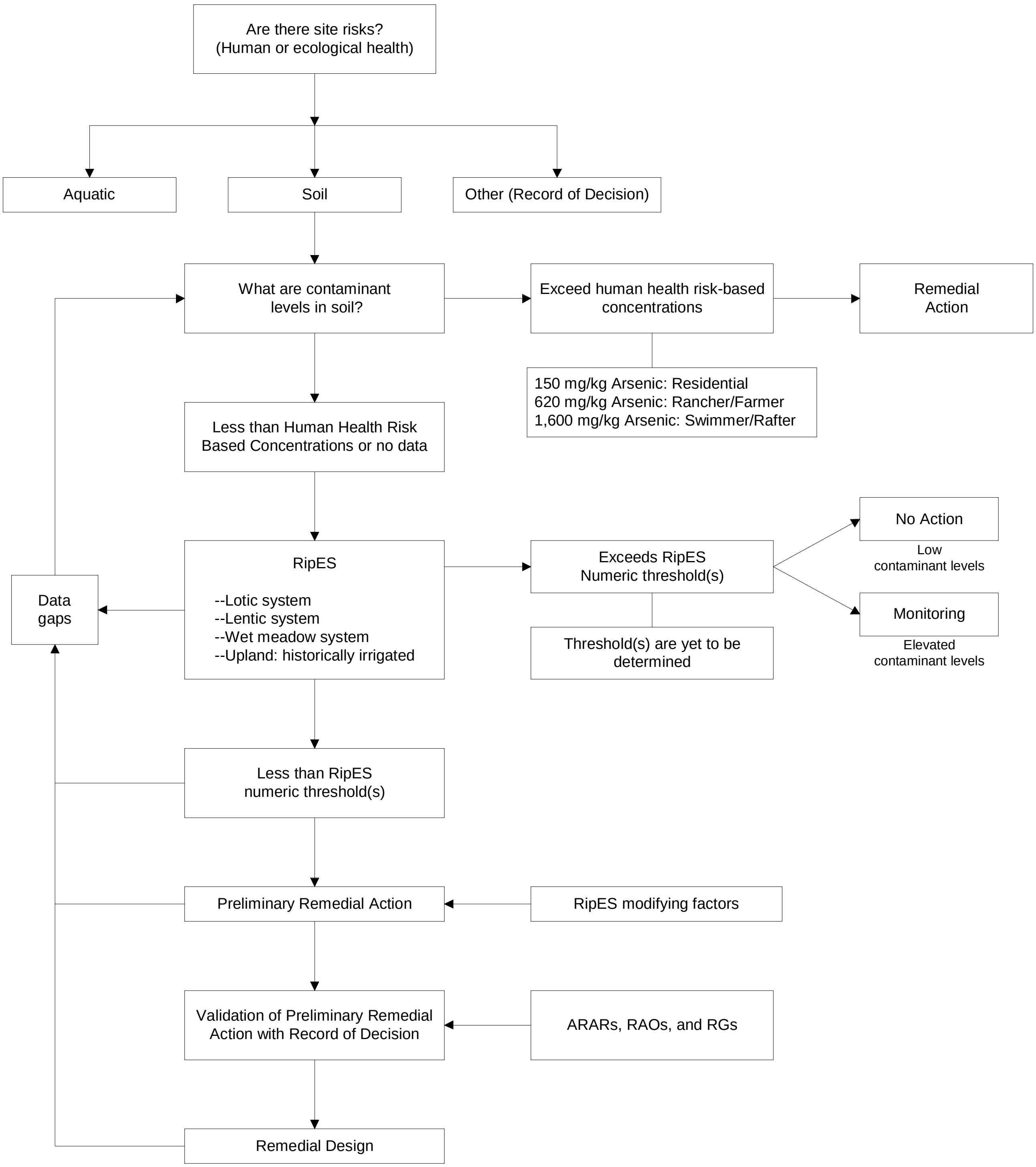


diagram is intended to serve as the logical foundation leading to remedial design at the polygon level.

The site-wide triggers for remedial action are risks to human and ecological health. The *Human Health Risk Assessment* (EPA 1998) and *Ecological Risk Assessment* (EPA 2001) established that risks were present within the Clark Fork River Operable Unit. The risk assessments did not indicate how, or specifically within the operable unit where, remedial action should occur. The Riparian Evaluation System is consequently designed to identify the specific areas where remedial action is warranted on the landscape based on observed levels of contamination, plant community characteristics, and erosional stability while also reflecting the removal and in-situ treatment criteria set forth in the preferred remedy.

Human Health Action Levels

Arsenic has been determined to be the principal threat to human health within the Clark Fork River Operable Unit. Chemicals of concern in addition to arsenic remain as valid action levels, although it is unlikely that these levels will be exceeded based on existing data.

The decision diagram implicates any soil contaminant level that exceeds the arsenic action level for the land use as a remedial action area. Polygons identified during the Riparian Evaluation System process will establish the spatial basis for the preliminary remedial action. Sub-polygons may be developed during the design process to address risks observed. When human health action levels are not exceeded in soil, the Riparian Evaluation System quantitative evaluation becomes the basis for assessment of ecological risk.

Riparian Evaluation System Quantitative Score

The numeric score derived from Riparian Evaluation System field evaluation is the trigger for remedial action based on attainment of a threshold score. The threshold scores have not yet been established, but will be developed during calibration of the Riparian Evaluation System. Scores that exceed the threshold score will be used to identify polygons where no further action is warranted and those where additional monitoring is appropriate. Polygons with low contaminant levels and exceeding the Riparian Evaluation System numeric threshold are categorized by the decision diagram as no action polygons. Polygons that exceed the numeric threshold, but exhibit residual elevation of contaminant levels are identified as areas of future monitoring.

Polygons that fail the Riparian Evaluation System numeric threshold will be identified as requiring remedial action to mitigate ecological risk caused by elevated contaminant levels in the soil. A preliminary remedial action intensity will be identified based on conditions observed in the evaluated polygon. Unique circumstances that ultimately temper the remedial action intensity will also be identified as modifying factors. Important modifying factors include land ownership, wetlands, historic resources, and land use considerations, as well as others. Preliminary remedial action intensities should be considered as initial impressions utilizing existing knowledge of the polygon. Data gaps will be identified, and following data collection, the preliminary remedial action will be adjusted. Remedial design will ultimately refine the preliminary remedial action developed through the Riparian Evaluation System process.

Data Gaps

Data gaps commonly include a shortage of analytical data from a polygon. A shortfall of analytical data can be problematic to assigning appropriate treatments during remedial design. For example, lime addition might be included in a remedial action, yet if no data exists within the polygon the design cannot move toward implementation until the lime rate is quantified. Similarly, if contaminant removal is included in design, the depth of contamination in the soil profile is required information. Additional data collection can occur at a number of points in the decision diagram. In each case, after new data is collected the decision diagram process is restarted with and assessment of contaminant levels in the soil. Reevaluation of the remedial design reflecting collection of new data allows consideration of human health action levels at the top of the decision logic.

Data gaps can also include informational parameters in addition to analytical parameters. Examples of informational parameters are vegetation condition on a specific streambank, historic resource surveys, stormwater runoff channel mapping, or others. The collection of informational parameters will assist with remedial design by allowing consideration of unique polygon characteristics.